Consumption Inequality across Heterogeneous Families

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Introduction

- Response of consumption to income shocks is a matter of practical significance
- Consistent empirical finding: household consumption significantly smoothed even with respect to very persistent shocks
- Suggests that households possess some form of consumption insurance, depends on available economic resources and household behavior
- Extensive preference heterogeneity across households $\rightarrow$ household behavior varies substantially in the presence of income shocks

Research question:

- What does preference heterogeneity imply for consumption inequality and consumption partial insurance?

How consumption responds to shocks is important

- Important for understanding how families get by when hit by adverse events, for designing government insurance, etc
- US micro data: most of insurance available to households is through household behavior
  - Blundell et al. 2016: savings (20%), family labor supply (60%)
  - Arellano et al. 2017: large heterogeneity in transmission of income into consumption
- Heterogeneity in household behavior gives rise to heterogeneity in the household response to income shocks

What this paper does

in a nutshell

- Develops and estimates a consumption lifecycle model with endogenous family labor supply
- Distinctive feature: households have general heterogeneous preferences over consumption and family labor supply
  - period utility $U(C, L_1, L_2)$ and discount factor are household specific
- Purpose:
  - link: wages $\rightarrow$ family labor supply $\rightarrow$ ... $\rightarrow$ consumption
  - implications for consumption inequality and partial insurance

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2. Preference heterogeneity accounts for 1/3 of consumption inequality
3. On average, consumption exhibits substantially less insurance than previously found in the literature
   (e.g. 35% lower than in Blundell et al. 2016)
   - family labor supply less effective insurance instrument as soon as model targets new information on skewness of earnings and consumption
   - distribution of partial insurance: includes full insurance and no insurance

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   (e.g. 35% lower than in Blundell et al. 2016)
   - family labor supply less effective insurance instrument as soon as model targets new information on skewness of earnings and consumption
   - distribution of partial insurance: includes full insurance and no insurance
4. Most shocks to male and female wages exhibit negative skewness
   (similar to Guvenen et al. 2015 for earnings shocks)

Relation to literature

- Large literature in labor and macro over 3+ decades that studies relationship between income and consumption inequality

  e.g. Deaton and Paxson 1994, Dynarski and Gruber 1997, Hyslop 2001, Attanasio et al. 2002, Krueger and Perri 2006, Blundell et al. 2008, Kaplan and Violante 2010, Guvenen and Smith 2014

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More recently, two distinct lines of work:

1. family labor supply ✓, heterogeneity ✘
   - family labor supply crucial for providing insurance
   - e.g. Blundell et al. 2016, Wu and Krueger 2021
2. heterogeneity ✓, family labor supply ✘
   - pervasive heterogeneity in transmission of income into consumption
   - e.g. Heathcote et al. 2014*, Arellano et al. 2017, Alan et al. 2018

   *male labor supply only, additive heterogeneity

Relation to literature

contribution

- To the **first group**, I add a very general preference heterogeneity; to the **second group**, I add family labor supply
- **Identification** of any moment of the distribution of consumption and labor supply Frisch elasticities
- **Estimate** the location and spread of these elasticities in the US
- **Quantify** implications for consumption inequality and partial insurance

- Closest papers: Blundell et al. 2016, Wu and Krueger 2021

1.
Model

Household problem

- A household consists of two spouses, each denoted by $j = \{1, 2\}$
- In each lifecycle period t, household i chooses

  consumption C_{it}, male hours H_{1it}, female hours H_{2it}, savings A_{it+1}

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$$\max \mathbb{E}_{\mathcal{I}} \sum_{t=0}^{T} \beta_i^t \, U_i(C_{it}, H_{1it}, H_{2it}; \boldsymbol{Z}_{it}) \tag{1}$$

$$\text{s.t. } \forall t: \quad P_t(1 + r_t)A_{it} + \sum_j W_{jit} H_{jit} = P_t C_{it} + P_t A_{it+1} \tag{2}$$

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- P_t is consumption price, r_t interest rate, W_{jit} hourly wage
- $\boldsymbol{Z}_{it}$ observable taste shifter (e.g. age) captures observed heterogeneity
- U_i and β_i subscripted by i to capture unobserved heterogeneity
  - e.g. composition of consumption basket, labor market attachment, C-L complementarity, risk preferences, discounting ...

Hourly wages

- Spouse-specific, idiosyncratic hourly wages W_{jit}
- Log wage is sum of three components: $\ln W_{jit} = \alpha_{jit} + w^p_{jit} + u_{jit}$
  - α_{jit} deterministic (due to education, age, etc)
  - w^p_{jit} permanent, unit root subject to **permanent shock** v_{jit}
  - u_{jit} **transitory shock**
- Familiar permanent-transitory process (e.g. MaCurdy 1982)

$$\Delta w_{jit} = v_{jit} + \Delta u_{jit} \tag{3}$$

  with $\Delta w_{jit} := \Delta \ln W_{jit} - \Delta \alpha_{jit}$

- Shocks are non-normal, freely correlated between spouses:
  - unrestricted second and higher moments, in line with recent work in income dynamics (De Nardi et al. 2019, Guvenen et al. 2021)

▸ all properties

Model solution

Two ways to solve the dynamic model (e.g. Low and Meghir 2017):

1. **Specify model fully** $\rightarrow$ obtain full policy function
   (e.g. numerically, via dynamic programming; Keane and Wolpin 1997)

2. **Specify model partially** $\rightarrow$ obtain part of policy function conditioning on sufficient statistics (e.g. approximation of FOCs, Euler equation; Chetty 2009)

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   - ✘ requires specification of U_i, β_i, $\mathbb{E}_{\mathcal{I}}$, shocks, and their distributions
   - ✘ expensive computationally (lines of code, memory, CPU)
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   - ✘ recovers certain parameters but cannot offer counterfactuals
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- Baseline: #2 for approximate consumption function non-parametrically
  (e.g. Blundell et al. 2008, Blundell et al. 2016)
- Robustness: #1 to check performance of approximation
  (e.g. Kaplan and Violante 2010, Wu and Krueger 2021)

Consumption dynamics

- Approximation of household behavior (à la Campbell 1993; Blundell et al. 2008): analytical expressions for consumption, earnings, hours growth

- Similarly for hours Δh_{jit} and earnings growth Δy_{jit}

▸ approx details ▸ role of observables, β ▸ wealth param ▸ all outcomes

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- Approximation of household behavior (à la Campbell 1993; Blundell et al. 2008): analytical expressions for consumption, earnings, hours growth
- Consumption growth in the model (net of observables):

$$\Delta c_{it} \approx \underbrace{\eta_{cw_1(it-1)} \times \Delta u_{1it}}_{\text{transmission of trans. shock 1}} + \underbrace{\eta_{cw_2(it-1)} \times \Delta u_{2it}}_{\text{transmission of trans. shock 2}}$$

$$+ \underbrace{f_1(\boldsymbol{\eta}_{it-1}; \pi_{it}, \boldsymbol{s}_{it}) \times v_{1it}}_{\text{transmission of perm. shock 1}} + \underbrace{f_2(\boldsymbol{\eta}_{it-1}; \pi_{it}, \boldsymbol{s}_{it}) \times v_{2it}}_{\text{transmission of perm. shock 2}}$$

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- Consumption growth heterogeneity due to shocks, preferences, wealth
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Preferences

Frisch elasticities η_{it} of household i at t

Consumption:	$\eta_{cw_1}(it)$
	$\eta_{cw_2}(it)$
	$\eta_{cp}(it)$
Male labor supply:	$\eta_{h_1 w_1}(it)$
	$\eta_{h_1 w_2}(it)$
	$\eta_{h_1 p}(it)$
Female labor supply:	$\eta_{h_2 w_1}(it)$
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- η_{it} describe U_i ordinally, not specific to a single parametrization

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Consumption:	$\eta_{cw_1}(it)$ $\eta_{cw_2}(it)$ $\eta_{cp}(it)$	$\leftarrow$ consumption substitution elasticity
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	$\eta_{h_2 p}(it)$	

- $\boldsymbol{\eta}_{it}$ describe U_i ordinally, not specific to a single parametrization
- $\boldsymbol{\eta}_{it}$ not deep parameters, depend on levels of consumption and hours
  - i-specific (heterogeneity), t-specific (underlying levels)
- $F_{\boldsymbol{\eta}_t}$ multivariate distribution of preferences across households
- $F_{\boldsymbol{\eta}_t}\left|\left(\boldsymbol{O}_t = (C_t, H_{1t}, H_{2t})\right)\right.$ is epicenter of preference heterogeneity

2.
Identification of Distribution of Preferences

Parameters

1. Wages: variance $\sigma^2_{v_j(t)}$, skewness $\gamma_{v_j(t)}$, higher moments
   - straightforward extension of Meghir and Pistaferri 2004
2. Preferences: first & higher moments of $F_{\boldsymbol{\eta}_t}|\boldsymbol{O}_t$ across households
   - conditional average elasticities $\mathbb{E}(\eta_{h_j w_j(it)})$ etc.
   - conditional variances & covariances $\mathrm{Var}(\eta_{cw_j(it)})$, $\mathrm{Cov}(\eta_{h_1 w_1(it)}, \eta_{h_2 w_2(it)})$ etc.

▸ identification wages ▸ wage measurement error

Identification

- **Assumption 1a. Exogeneity of wage shocks.**
  Conditional on observables, wage shocks do not depend on preferences U_i, consumption C_{it}, or labor supply H_{jit}.

- **Assumption 1b. Wage shocks do not enter the utility function.**
  Preferences η_{it} are independent of wage shocks, namely $\eta_{it} \perp v_{jit}, u_{jit}$, conditional on observables and the levels of C_{it} & H_{jit} that η_{it} depends on.

▸ identification in detail ▸ η analytically

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- **Proposition. Identification.**
  All moments of the joint distribution of (1.) labor supply elasticities, and (2.) consumption elasticities to wages are identified from panel data on consumption, earnings, wages, assets.

- No moment of $\eta_{cp(it)}$ is identified without strong additional assumptions, due to lack of cross-sectional variation in P_t

▸ identification in detail ▸ η analytically

Example and intuition

- Simplify consumption equation

$$\Delta c_{it} \approx \eta_{cw_1(it-1)} \Delta u_{1it} + \dots$$

- Given consumption and hours $\boldsymbol{O} = (C, H_1, H_2)$:

$$\frac{\mathbb{E}(\Delta c_{it} \times \Delta c_{it+1} \mid \boldsymbol{O}_{t-1}, \boldsymbol{O}_t)}{\mathbb{E}(\Delta w_{1it} \times \Delta w_{1it+1})} = \mathbb{E}(\eta^2_{cw_1(it)} | \cdot) \tag{4}$$

- **Intuition** –

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- **Intuition** – cross-sectional variation in consumption at fixed:
  - wages and prices
  - consumption and hours levels
  - observables

  masks heterogeneity in consumption preferences across households

- Motivated by Abowd and Card 1989:
  "most variation in earnings and hours occurs at fixed wage rates"

Example and intuition

third moments

- Reinstating full consumption equation renders identification more demanding but basic logic remains unchanged
  - correlation between shocks Δu_{1it} and Δu_{1it}
  - joint variation in $\eta_{cw_1(it)}$ and $\eta_{cw_2(it)}$ etc
- Additional information is required, for example through third moments
  - $\dfrac{\mathbb{E}(\Delta w_{1it} \times (\Delta c_{it+1})^2 \mid \boldsymbol{O}_t)}{\mathbb{E}(\Delta w_{1it} \times \Delta w_{1it+1})}$ mimics **IV**, type of impulse response
  - third moments not needed with preferences homogeneous
- Mapping from model to data suggests estimation strategy

▸ identification in detail ▸ identification η_{cp} ▸ measurement error ▸ η analytically

3.
Empirical Implementation and Parameter Estimates

Data

- Panel Study of Income Dynamics (PSID) over 1999-2011
  - similar to LISS in the Netherlands
- Long/nal data on earning, hours, consumption, assets in the household
  - consumption: non-durables (unlike Harmenberg 2021)

▸ PSID ▸ consumption measure ▸ PSID until 2017 ▸ sample ▸ selection ▸ descriptives

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- Panel Study of Income Dynamics (PSID) over 1999-2011
  - similar to LISS in the Netherlands
- Long/nal data on earning, hours, consumption, assets in the household
  - consumption: non-durables (unlike Harmenberg 2021)
- Stable married couples, 30-60 years old, who work in labor market
  - college attendance 70%, $\overline{Y}_1 = \$77\text{K}$, $\overline{Y}_2 = \$41\text{K}$, $\overline{C} = \$47\text{K}$ annually
  - arguably, selected sample with likely high insurance possibilities
  - main margin of selection: selection into work
- Wages, earnings, and consumption dynamics in sample

	$\Delta \log W_1$	$\Delta \log W_2$	$\Delta \log Y_1$	$\Delta \log Y_2$	$\Delta \log C$
volatility	0.494	0.449	0.537	0.608	0.289
skewness	0.161	-0.492	-1.017	-0.380	-0.062

Volatility: standard deviation. Skewness: third moment.

▸ PSID ▸ consumption measure ▸ PSID until 2017 ▸ sample ▸ selection ▸ descriptives

Estimation

- Fit 1^{st}, 2^{nd}, 3^{rd} moments of cross-sectional joint distribution of wage $\Delta \ln W_j$, earnings $\Delta \ln Y_j$, consumption $\Delta \ln C$
- Recover up to 3^{rd} moms. of shocks, up to 2^{nd} moms. of preferences
- Multi-stage estimation:
  1. remove effect of taste & wage observables (flexible OLS)
  2. estimate wage parameters (GMM)
  3. estimate moments of Frisch elasticities (GMM)
  4. block bootstrap over all steps for inference
- Simple code for steps 2-3 at `github.com/AlexTheloudis/Moments-Based-Econometrics-Course`

▸ first stage ▸ conditional moments ▸ standard errors ▸ measurement error

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- Simple code for steps 2-3 at `github.com/AlexTheloudis/Moments-Based-Econometrics-Course`
- Two tricky parts:
  - estimation of conditional moments in the data
  - several parameters on the boundary of parameter space, conventional standard errors inconsistent (but: Andrews 2000)

▸ first stage ▸ conditional moments ▸ standard errors ▸ measurement error

Results: wages

- Volatility (second moments)
  - permanent shocks $\sigma^2_{v_j} \approx 0.04$
  - transitory shocks $\sigma^2_{u_j} = 0.012$–0.024
  - shocks correlated between spouses $\rho = 0.11$–0.22
- Skewness (third moments)
  - most shocks exhibit substantially negative skewness, e.g. $\gamma_{u_1} = -0.018$, $\gamma_{v_2} = -0.015$
  - implying third standardized moments < -2
  - similar to earnings shocks of "millions of workers" in Guvenen et al 2021
  - limited co-skewness between spouses

▸ full wage results

Results: preferences

at sample average of consumption and hours

Several, gradually richer, specifications:

1. Up to 2^{nd} moments, homogeneous preferences
   - $\mathbb{E}(\eta_{h_1 w_1(it)}) = 0.406$ $\quad$ $\mathbb{E}(\eta_{h_2 w_2(it)}) = 0.446$ $\quad$ *male/female labor elasticity*

▸ full preference results ▸ diag GMM ▸ estimation η_{cp} ▸ standard errors

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2. Up to 3rd moments, homogeneous preferences
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   - $\mathbb{E}(\eta_{h_1 w_1(it)}) = 0.283$ $\quad$ $\mathbb{E}(\eta_{h_2 w_2(it)}) = 0.256$
3. Up to 3rd moments, preference heterogeneity
   - $\mathbb{E}(\eta_{h_1 w_1(it)}) = 0.276$ $\quad$ $\mathbb{E}(\eta_{h_2 w_2(it)}) = 0.247$

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   - $\mathbb{E}(\eta_{h_1 w_1(it)}) = 0.406$ $\quad$ $\mathbb{E}(\eta_{h_2 w_2(it)}) = 0.446$
2. Up to 3rd moments, homogeneous preferences
   - $\mathbb{E}(\eta_{h_1 w_1(it)}) = 0.283$ $\quad$ $\mathbb{E}(\eta_{h_2 w_2(it)}) = 0.256$
3. Up to 3rd moments, preference heterogeneity
   - $\mathbb{E}(\eta_{h_1 w_1(it)}) = 0.276$ $\quad$ $\mathbb{E}(\eta_{h_2 w_2(it)}) = 0.247$
   - $\mathrm{Var}(\eta_{h_1 w_1(it)}) = 0.018$ $\quad$ $\mathrm{Var}(\eta_{h_2 w_2(it)}) = 0.003$ $\quad$ (p-val > 0.15)

▸ full preference results ▸ diag GMM ▸ estimation η_{cp} ▸ standard errors

Results: preferences

at sample average of consumption and hours

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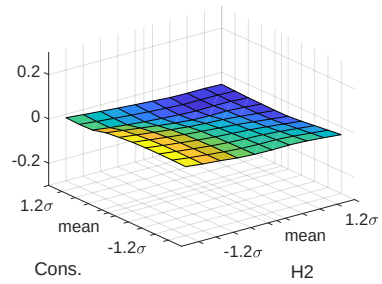
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   - $\mathrm{Var}(\eta_{cw_1(it)}) = 0.091$ $\quad$ $\mathrm{Var}(\eta_{cw_2(it)}) = 0.233$ $\quad$ (p-val ≈ 0.01)
     $\rightarrow$ large complementarities, one s.d. of η_{cw_1} about mean is in $(-0.33; 0.27)$

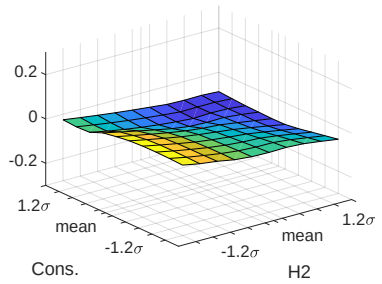
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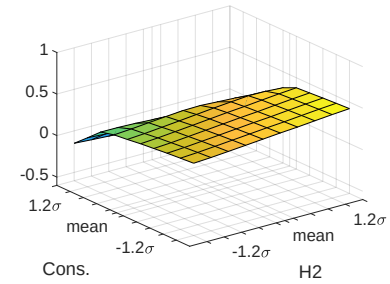
parameter estimates along the distribution of consumption and hours



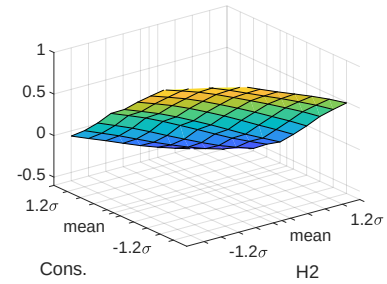
$\mathbb{E}(\eta_{cw_1(i)})$



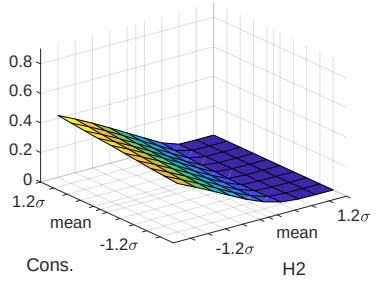
$\mathbb{E}(\eta_{cw_2(i)})$



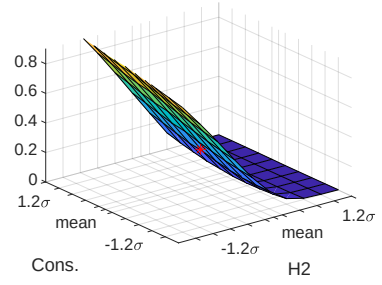
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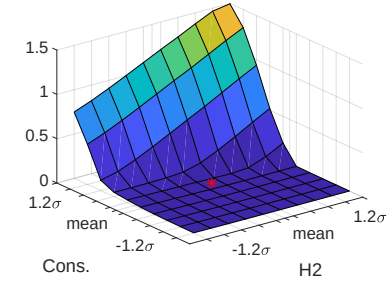
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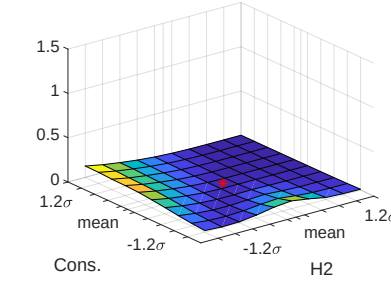
$\mathrm{Var}(\eta_{cw_1(i)})$



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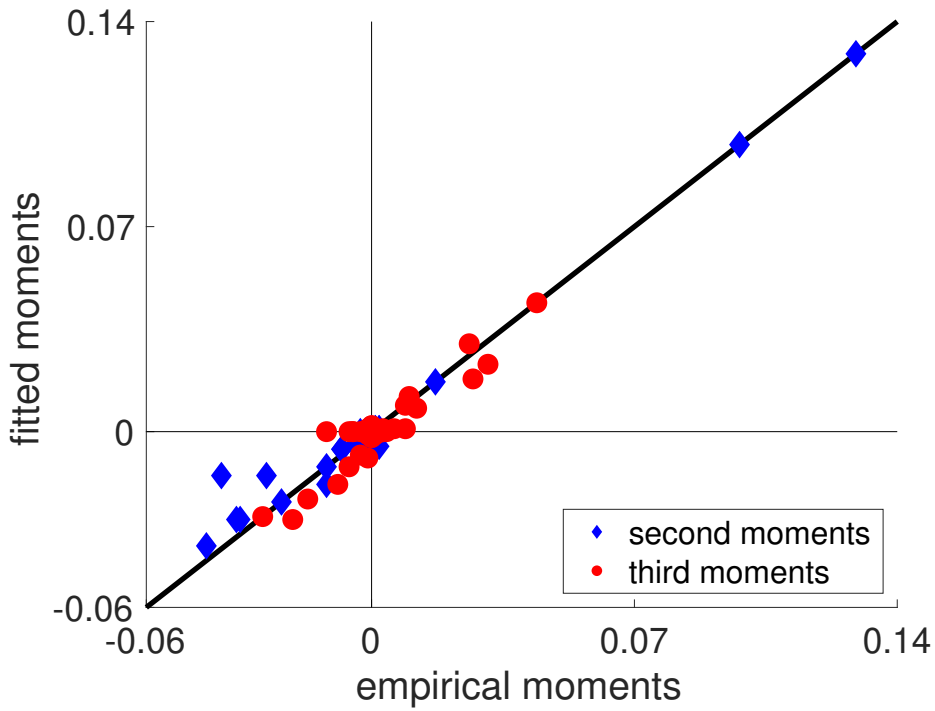
Selected parameters along the distribution of consumption and female hours within ± 1.5 st. dev. from their mean. I condition on the sample average of male hours.

- average elasticities stable
- heterogeneity in C elasticities $>>$ heterogeneity in H_j elasticities

▸ parameters over age ▸ parameters over time ▸ parameters over consumption error

Results: model fit

- Theoretical vs. target empirical moments
- Lots of overidentification, about 3 moments for each parameter
- 45° line indicates perfect fit



4.
Implications for Partial Insurance and Consumption Inequality

Consumption partial insurance

- Pass-through rates of shocks in the model:
  partial derivatives of consumption with respect to shocks

$$\begin{aligned}\Delta c_{it} \approx{}& \eta_{cw_1(it-1)}\ \Delta u_{1it} + \eta_{cw_2(it-1)}\ \Delta u_{2it} \\ &+ f_1(\boldsymbol{\eta}_{it-1}; \pi_{it}, \boldsymbol{s}_{it})\ v_{1it} + f_2(\boldsymbol{\eta}_{it-1}; \pi_{it}, \boldsymbol{s}_{it})\ v_{2it}\end{aligned}$$

- Transitory shocks: $\partial \Delta c_{it} / \partial u_{jit} = \eta_{cw_j(it-1)}$
  - straightforward given parameter estimates
- Permanent shocks: $\partial \Delta c_{it} / \partial v_{jit} = f_j(\boldsymbol{\eta}_{it-1}; \pi_{it}, \boldsymbol{s}_{it})$
  - nonlinear implicit function of preferences and wealth
  - simulate f_j for 10M households assuming elasticities $\boldsymbol{\eta}_{it}$ are jointly normal
  - draw wealth shares π_{it} and $\boldsymbol{s}_{it}$ from empirical distribution

▸ estimation of wealth

Insurance to transitory shocks

- $\mathbb{E}(\eta_{cw_j(it)}) = -0.03/-0.05$ and $\mathrm{Var}(\eta_{cw_j(it)}) = 0.09/0.23$

Pass-Through Rates of Transitory Shocks into Consumption

		$\partial\Delta c_{it}/\partial u_{jit}$ for household with preferences at		
	$\mathbb{E}(\frac{\partial\Delta c_{it}}{\partial u_{jit}})$	mean	mean $+1$ s.d.	mean -1 s.d.
u_{1it}	-0.03 (0.03)	-0.03	0.27	-0.33
u_{2it}	-0.05 (0.05)	-0.05	0.43	-0.54

Pass-through rates of transitory wage shocks at sample average of consumption and hours.

- $\mathbb{E}(\partial\Delta c/\partial u_j) \lessapprox 0 \rightarrow$ consumption, *on average*, fully insured against transitory shocks (e.g. Attanasio and Davis 1996, Blundell et al. 2008)

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- $\mathbb{E}(\partial \Delta c/\partial u_j) \lessapprox 0 \rightarrow$ consumption, *on average*, fully insured against transitory shocks (e.g. Attanasio and Davis 1996, Blundell et al. 2008)
- Consumption response substantial away from average preferences, varying degree of C-L complementarity (e.g. Meyer and Mok 2016)
  - estimates do not necessarily suggest equal mass on either side of average
- Consumption response may reflect liquidity constraints

Insurance to permanent shocks

- $\mathbb{E}(\partial \Delta c / \partial v_1) = 0.45$ and $\mathbb{E}(\partial \Delta c / \partial v_2) = 0.27$
  - 55% of male and 73% of female wage shock insured

- Pass-through about 35% higher ($\Rightarrow$ less insurance) than homogeneity benchmark in Blundell et al. 2016, Wu and Krueger 2021
  - limited insurance role of family labor supply
  - as soon as model targets third moments of earnings & consumption $\rightarrow$ male and female labor supply elasticities drop by 40%
  - Ghosh 2016: "*higher moments show no insurance to permanent shocks*"

▸ insurance via family labor

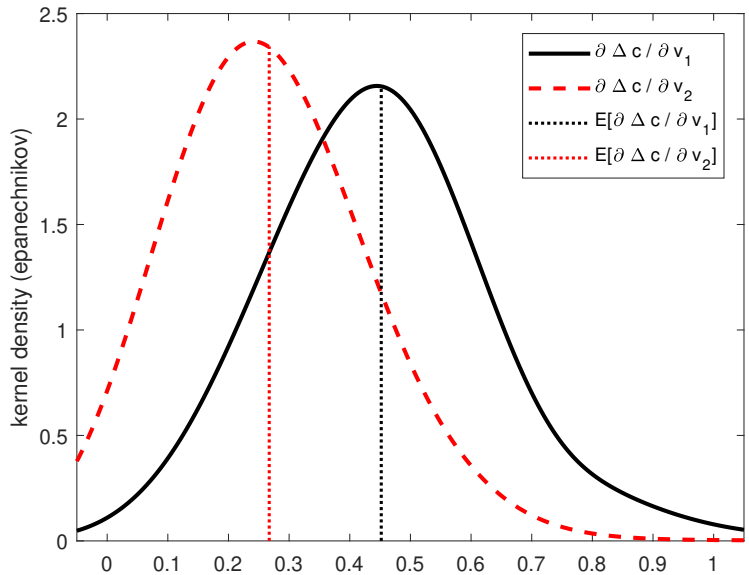
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- Family labor supply still mitigates transmission of wage shocks
  - yet role is smaller than in earlier papers
  - male and female labor supply equally effective here (equally responsive)
- Exogenous labor supply: $\mathbb{E}(\partial \Delta c / \partial v_1) = 0.50$ and $\mathbb{E}(\partial \Delta c / \partial v_2) = 0.31$
  - pass-through rates higher by about 15%
  - still substantial insurance via self-insurance and presence of two earners

▸ insurance via family labor

Insurance to permanent shocks: distribution

- Preference and wealth heterogeneity imply a distribution of partial insurance in the economy
- Distribution of $\partial \Delta c / \partial v_j$ under joint normality of preferences; financial and human wealth drawn from empirical distribution



- Includes full insurance & autarky extrema (as in Hryshko and Manovskii 2017)
- Aguiar et al. 2020 show preference relates to wealth heterogeneity $\rightarrow$ here two heterogeneities are assumed independent

Consumption inequality

$$\mathrm{Var}(\Delta c_{it}) \approx \underbrace{\mathrm{Var}\left(\eta_{cw_1(it-1)}\Delta u_{1it} + \eta_{cw_2(it-1)}\Delta u_{2it}\right)}_{\text{consumption instability: shocks + preferences}}$$

$$+ \underbrace{\mathrm{Var}\left(f_1(\boldsymbol{\eta}_{it-1}; \pi_{it}, \boldsymbol{s}_{it})v_{1it} + f_2(\boldsymbol{\eta}_{it-1}; \pi_{it}, \boldsymbol{s}_{it})v_{2it}\right)}_{\text{permanent inequality: shocks + preferences + wealth}}$$

- Describes inequality among households that start off life similarly
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- Describes inequality among households that start off life similarly
  - but agnostic about differences in initial consumption, hours, wealth
- Consumption inequality the result of three distinct forces:
  1. wage inequality
  2. preference heterogeneity (marginal and joint)
  3. wealth inequality
- Preference heterogeneity increases inequality
  - Heathcote et al. 2014 find this to be paramount for earnings inequality

Consumption inequality: decomposition

Accounting Decomposition of Consumption Inequality

		% of cons. inequality	% of cons. instability	% of perm. inequality
$\mathbf{Var}(\Delta c_{it})$	**0.055** (0.001)	100%		
consumption instability	**0.012**	21.5%	100%	
without pref. heterogeneity	0.000		1.2%	
pref. heterogeneity induced	0.012		98.8%	
permanent inequality	**0.043**	78.5%		100%
without heterogeneity	0.026			59.6%
heterogen. in preferences only	0.031			72%
heterogen. in preferences and wealth	0.043			100%

$\mathrm{Var}(\Delta c_{it})$ is net of consumption measurement error and estimated using GMM. A block bootstrap standard error from 1,000 replications is reported in parentheses. Simulations of permanent inequality assume preferences are jointly normal.

- Back-of-the-envelope calculation over the different components
  - wage inequality: 47%
  - preference heterogeneity: 31%
  - wealth inequality: 22%
- Contribution of preference + wealth heterogeneity similar as initial conditions heterogeneity in Huggett et al. 2011

5.
Discussion:
Additional Results and Quantitative Model

Can the results have alternative explanations?

model extensions

navigate literature | taxation | home production | collective model | ARMA(1,1) | time aggregation

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model extensions

1. Progressive joint taxation $Y_{it} = T_{it}(\sum_{j=1}^{2} W_{jit} H_{jit})$
2. Home production (Boerma and Karabarbounis 2019)
3. Intra-household heterogeneity (Lise and Seitz 2011)
4. Heterogeneity in wage dynamics (Hryshko and Manovskii 2017, Alan et al 2018)
   - persistence: $\Delta w_{jit} = (\rho_{ji} - 1) w^{p}_{jit-1} + v_{jit} + \Delta\zeta_{jit} + \tau_{ji}\Delta\zeta_{jit-1}$
5. Time aggregation of data in the PSID (Crawley 2020)

▸ navigate literature ▸ taxation ▸ home production ▸ collective model ▸ ARMA(1,1) ▸ time aggregation

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- Selection into work
- Liquidity constraints
- Approximation vs. parameterized quantitative model

▸ navigate literature ▸ taxation ▸ home production ▸ collective model ▸ ARMA(1,1) ▸ time aggregation

Selection into work

- Focus on hours because of approximation to household behavior; yet, neglecting extensive margin may limit insurance (e.g. Lundberg 1985)
- Extensive margin causes two problems:
  (1.) standard selection; (2.) approximation of FOCs not valid

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- Extensive margin causes two problems:
  (1.) standard selection; (2.) approximation of FOCs not valid
- Married couples 30-60 years: 94% of men and 81% of women work
  - female non-work related mostly to child-rearing
- Consider baseline vs. sample that includes non-participating women: target moments similar
  - consumption volatility – baseline: 0.29, everyone: 0.29
  - consumption skewness – baseline: -0.06, everyone: -0.07
- Quantitative model: negligible bias from extensive margin

Liquidity constraints

- Suppose true $\eta_{cw_j} < 0$ (Frisch substitution)
- Liquidity constraints bias this towards zero as consumption in constrained households moves along with wages
- Liquidity constraints cause two problems:
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- Suppose fraction ϱ_t of households have no assets, exogenous labor supply $\rightarrow$ hand-to-mouth, all shocks pass through to consumption

$$\Delta c_{it} \approx q_{1it-1}(v_{1it} + \Delta u_{1it}) + q_{2it-1}(v_{2it} + \Delta u_{2it})$$
$$\Delta y_{jit} = \Delta w_{jit}$$

where q_{jit} is spouse j's share of family earnings

Liquidity constraints

testable implications and results

- Implications of this environment are testable among unconstrained households
- Difficulty lies in determining who are the unconstrained
  - wealthy households as the theoretically unconstrained
  - I try different definitions of 'wealthy' (e.g. liquid wealth, Kaplan et al. 2014)

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  - I try different definitions of 'wealthy' (e.g. liquid wealth, Kaplan et al. 2014)
- Results do not support testable implications $\rightarrow$ not surprising!
  - Meyer et al. 2019: singles the vast majority of materially constrained
  - Aguiar et al. 2020: low wealth not necessarily 'hand-to-mouth'
  - Kaplan et al. 2014: MPC among continuously married 'hand-to-mouth' similar to unconstrained
- Quantitative model: negligible bias from liquidity constraints

▸ liquidity constraints details

Quantitative model

- How well does the approximation reflect true preferences?
- Simulate two-earner lifecycle model with endogenous labor supply; goal is to assess:
  1. how well approximation recovers preferences under heterogeneity
  2. identification content of target moments
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- Wu and Krueger 2021 $\rightarrow$ quantitative homogeneity benchmark
  - homogeneous preferences:
    $$U_t = \beta^t (1-\sigma)^{-1} \left(\{ \alpha C_{it}^{\gamma} + (1-\alpha)[\xi H_{1it}^{\theta} + (1-\xi) H_{2it}^{\theta}]^{-\frac{\gamma}{\theta}} \}^{\frac{1-\sigma}{\gamma}} - 1 \right)$$
  - straightforward extension to preference heterogeneity

▸ technical details

Quantitative model: results

- Population true preferences: households differ in parameters that control substitution between consumption, male hours, female hours

Quantitative Model: Estimates of Average Elasticities

		large sample		small sample	
	(1)	(2)	(3)	(4)	(5)
specification:	true	BPS	trans.	BPS	trans.
$\mathbb{E}(\eta_{cw_1(i)})$	-0.234	-0.212	-0.229	-0.211 (0.015)	-0.230 (0.024)
$\mathbb{E}(\eta_{cw_2(i)})$	-0.105	-0.122	-0.094	-0.123 (0.014)	-0.097 (0.041)
$\mathbb{E}(\eta_{h_1w_1(i)})$	1.016	1.058	1.024	1.062 (0.058)	1.026 (0.043)
$\mathbb{E}(\eta_{h_1w_2(i)})$	0.240	0.223	0.218	0.224 (0.021)	0.219 (0.018)
$\mathbb{E}(\eta_{h_2w_1(i)})$	0.516	0.537	0.525	0.542 (0.051)	0.527 (0.043)
$\mathbb{E}(\eta_{h_2w_2(i)})$	0.740	0.760	0.768	0.766 (0.052)	0.777 (0.073)

GMM estimates of first moments of wage elasticities based on simulated data. Large sample: pooled population with four sub-populations of 50K households, each with own preferences. Small sample: sample of 6032 from pooled population.

▸ additional results

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GMM estimates of first moments of wage elasticities based on simulated data. Large sample: pooled population with four sub-populations of 50K households, each with own preferences. Small sample: sample of 6032 from pooled population.

- Estimation performs well in large & small samples
  - intertemporal correlations, e.g. $\mathbb{E}(\Delta c_{it} \Delta c_{it+1})$, sufficient for identification
  - success also with heterogeneous σ (consumption IES) or β (discount factor)
  - bias from liquidity constraints and extensive margin small
- Contribution of heterogeneity to inequality: 5% ($t = 1$) to 40% ($t = T$)

▸ additional results

Conclusions

Summary

- This paper introduces preference heterogeneity in a lifecycle model of consumption and family labor supply
- Main findings:
  - substantial heterogeneity in consumption elasticities, little heterogeneity in labor supply elasticities
  - labor supply elasticities drop as soon as model targets 3^{rd} moments
  - consumption partial insurance drops, on average, lower
  - 1/3 of inequality explained by preference heterogeneity
- Seen together, studies of inequality and partial insurance should allow a role for higher moments and preference heterogeneity
- Moments beyond the workhorse covariance of consumption and income matter for partial insurance

A.
Model Appendix

Properties of wage shocks

1. Idiosyncratic with zero cross-sectional mean
2. Permanent and transitory shocks are independent but similar shocks correlated between spouses (e.g. assortative mating)
3. Non-normal, no serial correlation (for simplicity)
   - second moments (volatility): $\mathbb{E}(v_{1it}^{\nu} v_{2it}^{2-\nu}) = \begin{cases} \sigma^2_{v_1(t)} & \nu = 2 \\ \sigma_{v_1 v_2(t)} & \nu = 1 \\ \sigma^2_{v_2(t)} & \nu = 0 \end{cases}$
   - third moments (skewness): $\mathbb{E}(v_{1it}^{\nu} v_{2it}^{3-\nu}) = \begin{cases} \gamma_{v_1(t)} & \nu = 3 \\ \gamma_{v_1^2 v_2(t)} & \nu = 2 \\ \gamma_{v_1 v_2^2(t)} & \nu = 1 \\ \gamma_{v_2(t)} & \nu = 0 \end{cases}$
4. Illustration generalizes to higher moments

Approximation method

- Four main steps:
  1. obtain problem's first-order conditions
     $\rightarrow$ 3 intra-temporal (C, H_1, H_2) + Euler equation
  2. approximate intra-temporal FOCs
     $\rightarrow$ system of $\left.\begin{array}{l}\Delta \ln C_{it} \\ \Delta \ln H_{1it} \\ \Delta \ln H_{2it}\end{array}\right\}$
     as function of $\Delta \ln W_{1it}$ and $\Delta \ln W_{2it}$, taste observables $\boldsymbol{Z}_{it}$, growth in marginal utility of wealth $\Delta \ln \lambda_{it}$
  3. approximate Euler equation to decompose $\Delta \ln \lambda_{it}$ into two terms:
     (1.) anticipated gradient of consumption growth (function of r_t and β_i)
     (2.) innovation due to wage shocks
  4. log-linearize intertemporal budget constraint
     $\rightarrow$ express innovation to λ_t as function of wage shocks

- Further details in Blundell et al. 2008; details of the log-linearization of budget constraint in Campbell 1993

Approximation method

role of observables

- Combine 4 steps of previous point to obtain closed-form equations for consumption and earnings growth
- Equation are similar, e.g. for consumption

$$\begin{aligned}\Delta \ln C_{it} = &\text{ part 1 (taste, wage observables)} \\ &+ \text{part 2 (taste, wage observables; past levels; } r_t, \beta_i) \\ &+ \text{part 3 (wage shocks)}\end{aligned}$$

- Parts 1-2 not useful for estimating Frisch elasticities; β_i not identified
- Thus clear $\Delta \ln C_{it}$ of parts 1-2 to obtain *residual* consumption growth

$$\Delta c_{it} \equiv \Delta \ln C_{it} - \text{part 1} - \text{part 2}$$

- In the data: regress $\Delta \ln C_{it}$ flexibly on taste and wage observables, past levels of consumption C_{it-1} and hours H_{jit-1}

Financial & human wealth shares

- Financial wealth $\pi_{it} \approx \frac{\text{Assets}_{it}}{\text{Assets}_{it}+\text{Human Wealth}_{it}}$
  - reflects asset holdings in household
  - $\pi_{it} = 0$ if no assets; $\pi_{it} \to 1$ if assets $>>$ earnings
- Human wealth $s_{jit} \approx \frac{\text{Human Wealth}_{jit}}{\text{Human Wealth}_{it}}$
  - $\text{Human Wealth}_{jit} \approx Y_{jit} + \mathbb{E}_t \sum_{s=1}^{T} Y_{jit+s}/(1+r)^s$
  - $\text{Human Wealth}_{it} \approx \sum_j \text{Human Wealth}_{jit}$
  - reflects each spouse's contribution to household earnings
  - $s_{1it} \approx 0$ if female earnings $>>$ male earnings
- Both are directly estimable in the data:

Summary Statistics for Wealth Shares

	mean	med.	st.d.	min	max
s_{1it}	0.614	0.620	0.094	0.144	0.996
π_{it}	0.191	0.133	0.182	0.000	0.956

Hours and earnings dynamics

- Hours dynamics

$$\begin{aligned}\Delta h_{1it} \approx\ & \eta_{h_1 w_1(it-1)} \times \Delta u_{1it} + \eta_{h_1 w_2(it-1)} \times \Delta u_{2it} \\ & + g_1^{(1)}(\boldsymbol{\eta}_{it-1}; \pi_{it}, \boldsymbol{s}_{it}) \times v_{1it} + g_2^{(1)}(\boldsymbol{\eta}_{it-1}; \pi_{it}, \boldsymbol{s}_{it}) \times v_{2it}\end{aligned}$$

$$\begin{aligned}\Delta h_{2it} \approx\ & \eta_{h_2 w_1(it-1)} \times \Delta u_{1it} + \eta_{h_2 w_2(it-1)} \times \Delta u_{2it} \\ & + g_1^{(2)}(\boldsymbol{\eta}_{it-1}; \pi_{it}, \boldsymbol{s}_{it}) \times v_{1it} + g_2^{(2)}(\boldsymbol{\eta}_{it-1}; \pi_{it}, \boldsymbol{s}_{it}) \times v_{2it}\end{aligned}$$

- Labor supply elasticities
  - Male $\rightarrow$ $\eta_{h_1 w_1(it)}$ (own), $\eta_{h_1 w_2(it)}$ (cross-elasticity)
  - Female $\rightarrow$ $\eta_{h_2 w_2(it)}$ (own), $\eta_{h_2 w_1(it)}$ (cross-elasticity)
- Earnings dynamics: $\Delta y_{jit} = \Delta h_{jit} + \Delta w_{jit}$

Frisch elasticities

analytical expressions

- 9 Frisch elasticities: 3 goods (C, H_1, H_2) and 3 prices (P, W_1, W_2)
- Selected analytical expressions:
  - $\eta_{c,w_j(it)} = \frac{\partial C}{\partial W_j}\frac{W_j}{C}\Big|^{i,t}_{\lambda\text{-const.}} = Det^{-1}\frac{U_{H_j}}{C_{it}}(U_{CH_{-j}}U_{H_1H_2} - U_{CH_j}U_{H_{-j}H_{-j}})$
  - $\eta_{h_j,w_j(it)} = \frac{\partial H_j}{\partial W_j}\frac{W_j}{H_j}\Big|^{i,t}_{\lambda\text{-const.}} = Det^{-1}\frac{U_{H_j}}{H_{jit}}(U_{CC}U_{H_{-j}H_{-j}} - U^2_{CH_{-j}})$
  - $\eta_{c,p(it)} = \frac{\partial C}{\partial P}\frac{P}{C}\Big|^{i,t}_{\lambda\text{-const.}} = Det^{-1}\frac{U_C}{C_{it}}(U_{H_1H_1}U_{H_2H_2} - U^2_{H_1H_2})$
- The determinant Det and all partial derivatives of utility function U depend on contemporary outcomes C_{it}, H_{1it}, and H_{2it}
- Separability in U simplifies these expressions

B.
Identification Appendix

Identification: wage process

- Identification follows Meghir and Pistaferri 2004, and earlier papers
- Second moments:
  - $\sigma^2_{v_j(t)} = \mathbb{E}\left(\Delta w_{jit} \times (\Delta w_{jit-1} + \Delta w_{jit} + \Delta w_{jit+1})\right)$
  - $\sigma^2_{u_j(t)} = -\mathbb{E}\left(\Delta w_{jit} \times \Delta w_{jit+1}\right) - \sigma^2_{e_j^W(t)}$
- Third moments:
  - $\gamma_{v_j(t)} = \mathbb{E}\left((\Delta w_{jit})^2 \times (\Delta w_{jit-1} + \Delta w_{jit} + \Delta w_{jit+1})\right)$
  - $\gamma_{u_j(t)} = -\mathbb{E}\left((\Delta w_{jit})^2 \times \Delta w_{jit+1}\right) - \gamma_{e_j^W(t)}$
- Second and third *cross*-moments follow similarly, logic extends to higher moments of shocks
- Impossible to separate the transitory shock from moments of wage measurement error e^W_{jit}
  - use external estimate for $\sigma^2_{e_j^W}$ from validation study of Bound et al. 1994
  - assume wage measurement error is Gaussian ($\gamma_{e_j^W} = 0$)

Identification: preferences

- Consider the consumption-wage elasticities η_{cw_1} and η_{cw_2}
- Average elasticities across households
  - $\mathbb{E}\left(\Delta w_{1it+1} \times \Delta c_{it} | \boldsymbol{O}_{t-1}\right) = -\mathbb{E}(\eta_{cw_1(it)})\sigma^2_{u_1(t)} - \mathbb{E}(\eta_{cw_2(it)})\sigma_{u_1u_2(t)}$
  - $\mathbb{E}\left(\Delta w_{2it+1} \times \Delta c_{it} | \boldsymbol{O}_{t-1}\right) = -\mathbb{E}(\eta_{cw_2(it)})\sigma^2_{u_2(t)} - \mathbb{E}(\eta_{cw_1(it)})\sigma_{u_1u_2(t)}$
- Variances and covariance of elasticities across households
  - $\mathbb{E}(\Delta c_{it} \times \Delta c_{it+1} | \boldsymbol{O}_{t-1}, \boldsymbol{O}_t) =$
    $-\mathbb{E}(\eta^2_{cw_1(it)})\sigma^2_{u_1(t)} - \mathbb{E}(\eta^2_{cw_2(it)})\sigma^2_{u_2(t)} - 2\mathbb{E}(\eta_{cw_1(it)}\eta_{cw_2(it)})\sigma_{u_1u_2(t)}$
  - $\mathbb{E}\left(\Delta w_{1it+1} \times (\Delta c_{it})^2 | \boldsymbol{O}_{t-1}\right)) =$
    $-\mathbb{E}(\eta^2_{cw_1(it)})\gamma_{u_1(t)} - \mathbb{E}(\eta^2_{cw_2(it)})\gamma_{u_1u_2^2(t)} - 2\mathbb{E}(\eta_{cw_1(it)}\eta_{cw_2(it)})\gamma_{u_1^2u_2(t)}$
  - $\mathbb{E}\left(\Delta w_{2it+1} \times (\Delta c_{it})^2 | \boldsymbol{O}_{t-1}\right)) =$
    $-\mathbb{E}(\eta^2_{cw_2(it)})\gamma_{u_2(t)} - \mathbb{E}(\eta^2_{cw_1(it)})\gamma_{u_2u_1^2(t)} - 2\mathbb{E}(\eta_{cw_1(it)}\eta_{cw_2(it)})\gamma_{u_2^2u_1(t)}$
- Identification of all other elasticities follows similarly (with plenty of over-identifying restrictions)

Identification: consumption substitution elasticity

- $\eta_{c,p}$ matters for sensitivity of budget constraint to permanent shocks
- In the absence of observed cross-sectional variation in P_t, identification must come from transmission of permanent shocks
  $\rightarrow$ **lifecycle Marshallian elasticities** (Attanasio et al. 2018)
- Assume separable utility, $\pi_{it} = 0$, $s_{jit} = 1/2$; Marshallian elasticity C/W_1:

$$f_1(\boldsymbol{\eta}_{it-1}; \pi_{it}, s_{it}) = \frac{\eta_{cp(it-1)}\left(1 + \eta_{h_1 w_1(it-1)}\right)}{2\eta_{cp(it-1)} - \eta_{h_1 w_1(it-1)} - \eta_{h_2 w_2(it-1)}}$$

- f_1 identified but this does not identify $\eta_{c,p}$ due to non-linearity
  - requires homogeneous η_{cp} as in Blundell et al. 2016
  - and parameterization of distribution of preferences to simulate f_1
- After estimating other preferences non-parametrically, I assume joint normality and estimate $\eta_{cp} = -0.598$

Identification: preferences

measurement error

- Suppose error in variables is classical and independent across outcomes (last point not true for *wages* as wages $=$ earnings $/$ hours)
- Identifying moments are modified as follows
  - $\mathbb{E}(\Delta c_{it} \times \Delta c_{it+1} | \boldsymbol{O}_{t-1}, \boldsymbol{O}_t) = f^{(c)}(\text{preferences, shocks}) - \sigma^2_{e^C(t)}$
  - $\mathbb{E}(\Delta h_{jit} \times \Delta h_{jit+1} | \boldsymbol{O}_{t-1}, \boldsymbol{O}_t) = f^{(h_j)}(\text{preferences, shocks}) - \sigma^2_{e^H_j(t)}$
- Bound et al. 1994 provides external estimate for $\sigma^2_{e^H_j(t)}$
- Consumption error unavailable, so I fix $\sigma^2_{e^C(t)} = 15\% \times \text{Var}(\Delta \ln C_{it})$
  - earnings measurement is 4% of earnings variance
  - wage measurement is 13% of wage variance
  - also check results for $\sigma^2_{e^C(t)} = \chi\% \times \text{Var}(\Delta \ln C_{it})$ where $\chi = \{0, \ldots 50\}$

C.
Data, Estimation, Results Appendix

Overview of PSID

- Started in 1968 tracking a -then- nationally representative sample of households and their linear descendants
- Two main samples:
  - representative ('SRC' sample)
  - lower-income households ('SEO' sample)
- Annual until 1997: detailed information on incomes, employment, food expenditure, demographics
- Biennial after 1997: information also on consumption and wealth
- Arguably one of the best longitudinal datasets with information on consumption, wealth, time use, earnings

Consumption measure

- Nondurable consumption in the PSID includes:
  1. **food**: prepared or delivered at home, away from home
  2. **housing**: rent, rent equivalent for homeowners, house insurance
  3. **utilities**: gas, electricity, water and sewage, telecommunications
  4. **mobility**: vehicles (insurance, repairs, parking, gasoline), public transport
  5. **children**: child care, school expenses
  6. **medical**: nursing homes and hospital bills, doctor, dentists, prescriptions
- Main items missing: clothing, recreation, tobacco, alcohol
- Items 1-6 available consistently in 1999-2011
- Changes and errors in consumption/wealth after 2011:
  - **medical**: nursing homes and hospital bills jump in 2013
  - **medical**: doctors and drugs change in an unclear way in 2015
  - **mobility**: vehicle costs change in 2015 due to coding error
  - **wealth**: other real estate & value of business/farm not included after 2011

Sample selection

1. Seven waves of the PSID: biennial data in 1999-2011
   - two main samples: representative ('SRC') & lower-income ('SEO')
   - use first sample only for consistency with Blundell et al. 2016 and Wu and Krueger 2021
2. Married opposite-sex couples between 30-60 years old
   - stable continuously married couples that appear more than once
3. No missing demographics, earnings, consumption; wealth $<$ \$20M
   - remove 'extreme jumps' from t to $t+1 \rightarrow$ measurement error
4. Up to this point, 94% of men & 81% of women participate in the market
5. Selection into work: both spouses participate
   - hourly wages $> 0.5 \times$ state minimum wage

Descriptive statistics

Baseline Sample

	Mean	Median	St.dev.
Male earner			
Earnings	77466	58181	121938
Hours of work	2254	2205	614
Hourly wage	35.4	26.3	72.9
Age	45.1	45.0	7.8
Some college %	67.3	100.0	46.9
Female earner			
Earnings	41663	34612	36166
Hours of work	1730	1880	667
Hourly wage	24.5	19.6	29.6
Age	43.4	43.0	7.6
Some college %	70.8	100.0	45.5
Household consumption			
Total consumption	47307	40850	26373
food at home	7102	6606	3550
vehicles[a]	7136	5298	6653
education	3517	0	9538
medical expenses[b]	3657	2547	4266
utilities	4835	4436	2761
housing[c]	16731	12980	13924
Household assets and debt [in thousands]			
Total wealth	408.5	180.7	878.6
Home equity[d]	131.5	80.8	179.9
Other debt	12.3	2.7	29.1
# of children	1.0	1.0	1.1
Observations		8308	

All monetary amounts are in 2010 dollars. Earnings, hours, consumption and wealth/debt are annual.
[a]including gasoline; [b]including health insurance and prescriptions; [c]including home insurance, rent,
[d]and rent equivalent for homeowners; the present value of owned house net of outstanding mortgages.

First stage estimation

- Consistent with statistical model for wages, regress $\Delta \ln W_{jit}$ on
  - **dummies** for year, age, education, race, US state, interactions
  - residual is $\Delta w^*_{jit} = \Delta w_{jit} + \Delta e^w_{jit}$
- Consistent with model, regress $\Delta \ln Y_{jit}$ on
  - above dummies for *both* spouses
  - **dummies** for # children, # household members, employment status, income support or receipt outside household, interactions, $\Delta \times t$
  - past levels of consumption C_{it-1} and hours H_{1it-1}, H_{2it-1}
  - residual is $\Delta y^*_{jit} = \Delta w_{jit} + \Delta h_{jit} + \Delta e^y_{jit}$
- Repeat last point for consumption $\Delta \ln C_{it}$
  - residual is $\Delta c^*_{it} = \Delta c_{it} + \Delta e^c_{it}$
- Control for past levels: intercepts in equations for $\Delta \ln Y_{jit}$ & $\Delta \ln C_{it}$ depend on past levels under preference heterogeneity

Conditional moments

- Estimation requires moments of Δc_{it} and Δy_{jit} conditional on consumption and hours $\boldsymbol{O}_t = (C_t, H_{1t}, H_{2t})$

Two ways to do this:

1. Nonparametric estimation of $\mathbb{E}(\Delta w_{jit}\Delta c_{it+1}|\boldsymbol{O}_t)$, $\mathbb{E}(\Delta c_{it}\Delta c_{it+1}|\boldsymbol{O}_{t-1}, \boldsymbol{O}_t)$ etc along the support of conditioning variables
   - non-parametric, hoping there are enough observations to permit this
   - requires excessive amount of data (even with grouping) ✘

2. Explicitly model dependence of moments on $\boldsymbol{O}_t$ and $\boldsymbol{O}_{t-1}$, e.g.

$$\begin{aligned}\Delta w_{jit}\Delta c_{it+1} &= \gamma_0 + \boldsymbol{\gamma}_1'\boldsymbol{O}_{it} + \epsilon_{it}^{w_j c}\\ \Delta c_{it}\Delta c_{it+1} &= \delta_0 + \boldsymbol{\delta}_1'\boldsymbol{O}_{it} + \boldsymbol{\delta}_2'\boldsymbol{O}_{it-1} + \epsilon_{it}^{cc},\end{aligned}$$

   then obtain fitted values for given $\boldsymbol{O}_t$ and $\boldsymbol{O}_{t-1}$
   - feasibility in small datasets
   - permits to address possible dependence on other variables
   - requires $\mathbb{E}(\epsilon_{it}|\boldsymbol{O}_{t-1}, \boldsymbol{O}_t) = 0$, which is internally consistent with model

Standard errors

- Block bootstrap given multi-stage estimation (e.g. Horowitz 2001)
- 1,000 random samples, repeating all stages of the estimation

Two types of parameters:

1. Always away from boundary of parameter space, e.g. $\mathbb{E}(\eta_{c,w_j(it)})$
   - bootstrap consistent
2. Possibly on boundary of parameter space, e.g. $\mathrm{Var}(\eta_{c,w_j(it)})$
   - bootstrap not consistent (Andrews 2000)
   - report p-value for $\mathcal{H}_0 : \theta = 0 \quad$ against $\quad \mathcal{H}_a : \theta > 0$
   - obtain p-value as $1-$ share of replications for which

     $$n^{1/2}\hat{\theta} > n^{1/2}(\hat{\theta}^* - \hat{\theta})$$

     where $\hat{\theta}^*$ is bootstrap estimate and $\hat{\theta}$ is the original parameter estimate
   - bootstrap test has correct asymptotic rejection rate for $p \in (0, 1/2)$

Results: wages

Estimates of Wage Parameters

	men		women		household			
Panel A: *Second moments*								
permanent	$\sigma^2_{v_1}$	0.041 (0.006)	$\sigma^2_{v_2}$	0.037 (0.004)	$\sigma_{v_1 v_2}$	0.005 (0.002)	$\rho_{v_1 v_2}$	0.118 (0.054)
transitory	$\sigma^2_{u_1}$	0.024 (0.006)	$\sigma^2_{u_2}$	0.012 (0.005)	$\sigma_{u_1 u_2}$	0.004 (0.002)	$\rho_{u_1 u_2}$	0.223 (0.161)
Panel B: *Third moments*								
permanent	γ_{v_1}	0.022 (0.030)	γ_{v_2}	-0.015 (0.005)	$\gamma_{v_1 v_2^2}$	0.001 (0.002)	$\gamma_{v_1^2 v_2}$	0.005 (0.002)
transitory	γ_{u_1}	-0.018 (0.008)	γ_{u_2}	-0.008 (0.006)	$\gamma_{u_1 u_2^2}$	0.000 (0.001)	$\gamma_{u_1^2 u_2}$	0.000 (0.004)

GMM estimates of the parameters of the wage process (second and third moments of shocks) under stationarity over time. Block bootstrap standard errors are in parentheses based on 1,000 bootstrap replications.

Results: preferences

Estimates of Preferences: Means and Variances at Sample Average of Consumption and Hours

(follows paper:)	(2)	(3)	(4)	(5)	(6)	(8)
specification/moments:	BPS-repl.	2^{nd}	2^{nd} & 3^{rd}	2^{nd} & 3^{rd}	2^{nd} & 3^{rd}	2^{nd} & 3^{rd}
heterogeneity:	no	no	no	marginal	joint	preferred
	2011 data, past levels	only transitory	third moments	marg. hetero-geneity	joint hetero-geneity	mild homogeneity
$\mathbb{E}(\eta_{cw_1(i)})$	-0.237	0.029	-0.020	-0.020	-0.041	-0.033
	(0.058)	(0.062)	(0.059)	(0.053)	(0.062)	(0.032)
$\mathbb{E}(\eta_{cw_2(i)})$	0.047	-0.107	-0.054	-0.045	-0.032	-0.053
	(0.049)	(0.117)	(0.084)	(0.070)	(0.075)	(0.052)
$\mathbb{E}(\eta_{h_1w_1(i)})$	0.589	0.406	0.283	0.282	0.276	0.276
	(0.174)	(0.151)	(0.125)	(0.126)	(0.125)	(0.120)
$\mathbb{E}(\eta_{h_1w_2(i)})$	0.089	-0.049	-0.010	-0.010	-0.009	
	(0.054)	(0.062)	(0.048)	(0.047)	(0.047)	
$\mathbb{E}(\eta_{h_2w_1(i)})$	0.186	-0.102	-0.020	-0.020	-0.019	
	(0.112)	(0.128)	(0.100)	(0.098)	(0.098)	
$\mathbb{E}(\eta_{h_2w_2(i)})$	0.776	0.446	0.256	0.255	0.254	0.247
	(0.153)	(0.294)	(0.220)	(0.224)	(0.227)	(0.196)
$\mathrm{Var}(\eta_{cw_1(i)})^{\#}$				0.081	0.097	0.091
				[0.144]	[0.106]	[0.014]
$\mathrm{Var}(\eta_{cw_2(i)})^{\#}$				0.269	0.259	0.233
				[0.137]	[0.130]	[0.014]
$\mathrm{Var}(\eta_{h_1w_1(i)})^{\#}$				0.002	0.020	0.018
				[0.132]	[0.214]	[0.209]
$\mathrm{Var}(\eta_{h_1w_2(i)})^{\#}$				0.000	0.000	
				[0.178]	[0.232]	
$\mathrm{Var}(\eta_{h_2w_1(i)})^{\#}$				0.001	0.003	
				[0.195]	[0.231]	
$\mathrm{Var}(\eta_{h_2w_2(i)})^{\#}$				0.001	0.004	0.003
				[0.055]	[0.167]	[0.152]

Observations across columns 2-8: 6071 (households $\times \Delta_t$). $^{\#}$ p-value in square brackets for the one-sided test that the respective parameter equals zero.

Results: preferences

Estimates of Preferences: Covariances at Sample Average of Consumption and Hours

(follows paper:)	(2)	(3)	(4)	(5)	(6)	(8)
$\mathrm{Cov}(\eta_{cw_1(i)}, \eta_{cw_2(i)})$					0.001	0.146
					(0.009)	(0.050)
$\mathrm{Cov}(\eta_{cw_1(i)}, \eta_{h_1w_1(i)})$					0.040	0.036
					(0.035)	(0.024)
$\mathrm{Cov}(\eta_{cw_1(i)}, \eta_{h_1w_2(i)})$					0.000	
					(0.005)	
$\mathrm{Cov}(\eta_{cw_1(i)}, \eta_{h_2w_1(i)})$					-0.001	
					(0.009)	
$\mathrm{Cov}(\eta_{cw_1(i)}, \eta_{h_2w_2(i)})$					-0.002	-0.008
					(0.011)	(0.017)
$\mathrm{Cov}(\eta_{cw_2(i)}, \eta_{h_1w_1(i)})$					0.016	0.058
					(0.025)	(0.038)
$\mathrm{Cov}(\eta_{cw_2(i)}, \eta_{h_1w_2(i)})$					0.001	
					(0.004)	
$\mathrm{Cov}(\eta_{cw_2(i)}, \eta_{h_2w_1(i)})$					0.002	
					(0.009)	
$\mathrm{Cov}(\eta_{cw_2(i)}, \eta_{h_2w_2(i)})$					-0.020	-0.013
					(0.029)	(0.027)
$\mathrm{Cov}(\eta_{h_1w_1(i)}, \eta_{h_1w_2(i)})$					0.000	
					(0.003)	
$\mathrm{Cov}(\eta_{h_1w_1(i)}, \eta_{h_2w_1(i)})$					0.000	
					(0.006)	
$\mathrm{Cov}(\eta_{h_1w_1(i)}, \eta_{h_2w_2(i)})$					-0.002	-0.003
					(0.016)	(0.019)
$\mathrm{Cov}(\eta_{h_1w_2(i)}, \eta_{h_2w_1(i)})$				0.000	0.000	
				(0.001)	(0.001)	
$\mathrm{Cov}(\eta_{h_1w_2(i)}, \eta_{h_2w_2(i)})$					0.000	
					(0.001)	
$\mathrm{Cov}(\eta_{h_2w_1(i)}, \eta_{h_2w_2(i)})$					0.000	
					(0.002)	

Observations across columns 2-8: 6071 (households $\times \Delta_t$).

Results: preferences (diagonally weighed GMM)

at sample average of consumption and hours

Several, gradually richer, specifications:

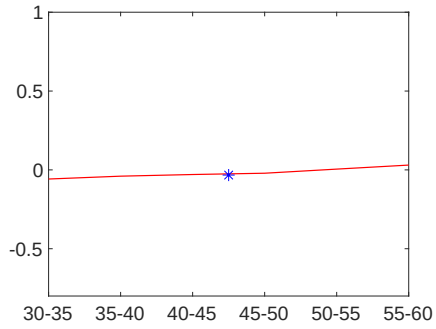
1. Up to 2nd moments, homogeneous preferences
   - $\mathbb{E}(\eta_{h_1 w_1(it)}) = 0.401$ $\quad$ $\mathbb{E}(\eta_{h_2 w_2(it)}) = 0.437$ $\quad$ *male/female labor elasticity*
2. Up to 3rd moments, homogeneous preferences
   - $\mathbb{E}(\eta_{h_1 w_1(it)}) = 0.324$ $\quad$ $\mathbb{E}(\eta_{h_2 w_2(it)}) = 0.298$
3. Up to 3rd moments, preference heterogeneity
   - $\mathbb{E}(\eta_{h_1 w_1(it)}) = 0.287$ $\quad$ $\mathbb{E}(\eta_{h_2 w_2(it)}) = 0.210$
   - $\mathrm{Var}(\eta_{h_1 w_1(it)}) = 0.068$ $\quad$ $\mathrm{Var}(\eta_{h_2 w_2(it)}) = 0.037$ $\quad$ (p-val > 0.25)
   - $\mathbb{E}(\eta_{cw_1(it)}) = -0.017$ $\quad$ $\mathbb{E}(\eta_{cw_2(it)}) = -0.032$ $\quad$ (p-val ≈ 0.51)
   - $\mathrm{Var}(\eta_{cw_1(it)}) = 0.036$ $\quad$ $\mathrm{Var}(\eta_{cw_2(it)}) = 0.130$ $\quad$ (p-val < 0.1)

     $\rightarrow$ large complementarities, one s.d. of η_{cw_1} about mean is in $(-0.33; 0.27)$

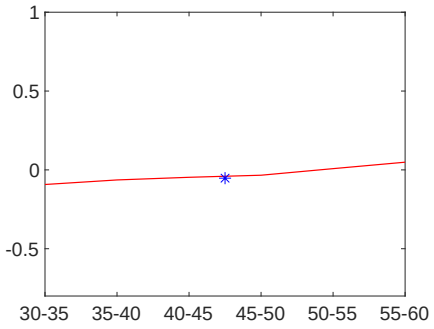
Results: consumption substitution elasticity

- Estimation of wage elasticities did not require parametric restrictions
- But estimation of η_{cp} not possible without additional restrictions:
  - homogeneous η_{cp} as in Blundell et al. 2016
  - parameterization of distribution of wage elasticities to simulate lifecycle Marshallian elasticity f_1 and f_2
- To avoid subjecting all parameters to these restrictions, I estimate η_{cp} in a second stage
- I use $\mathrm{Var}(\Delta c_{it})$, involves Marshallian elasticities f_1 and f_2
  - simulated minimum distance as $\mathrm{Var}(\Delta c_{it})$ is nonlinear in η_{cp}
  - 10M random households, simulation as in consumption inequality section
- Distance metric minimized at $\widehat{\eta}_{cp} = -0.598$ implying a coefficient of relative risk aversion ≈ 1.67

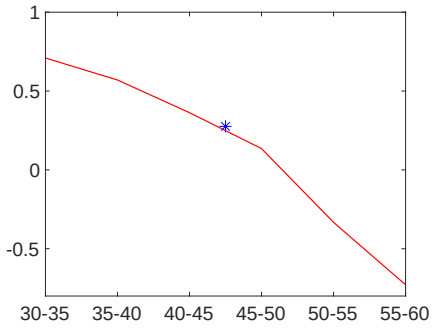
Results: preferences (over age)



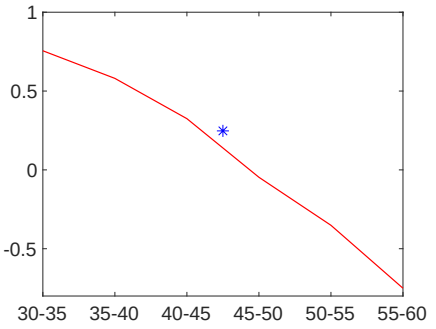
$\mathbb{E}(\eta_{cw_1(i)})$



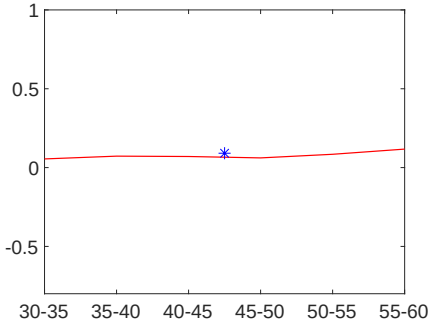
$\mathbb{E}(\eta_{cw_2(i)})$



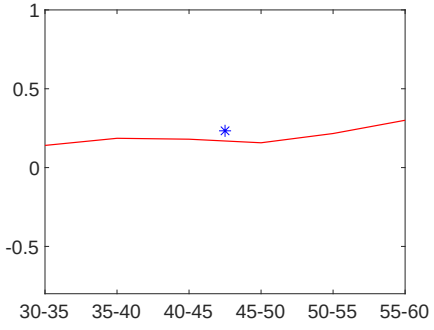
$\mathbb{E}(\eta_{h_1w_1(i)})$



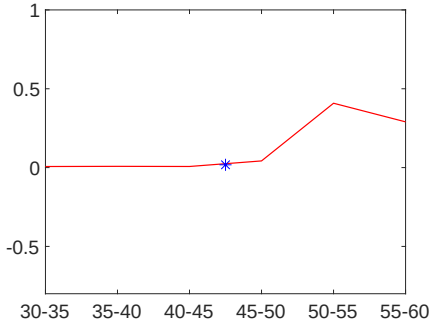
$\mathbb{E}(\eta_{h_2w_2(i)})$



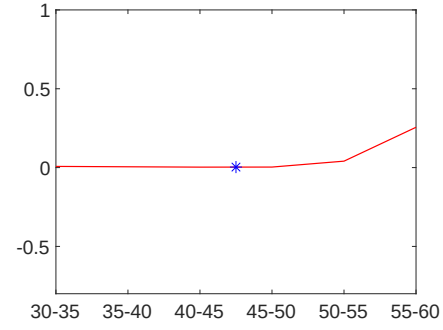
$\mathrm{Var}(\eta_{cw_1(i)})$



$\mathrm{Var}(\eta_{cw_2(i)})$



$\mathrm{Var}(\eta_{h_1w_1(i)})$

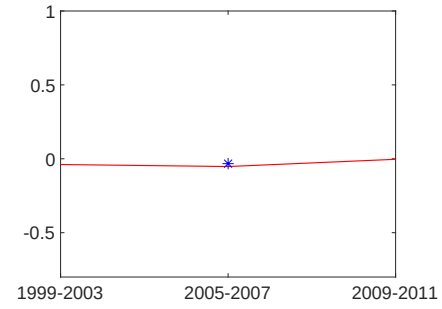


$\mathrm{Var}(\eta_{h_2w_2(i)})$

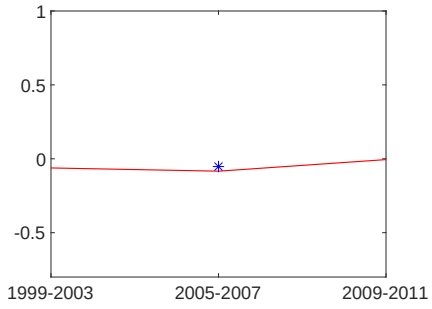
Selected parameters over six age brackets: 30-35, 35-40, 40-45, 45-50, 50-55, and 55-60. I condition on the sample average of consumption and hours within each age bracket.

- $\mathbb{E}(\eta_{cw_j(it)})$ stable, $\mathbb{E}(\eta_{h_jw_j(it)})$ negative at older ages
- pattern of heterogeneity remarkably similar to baseline

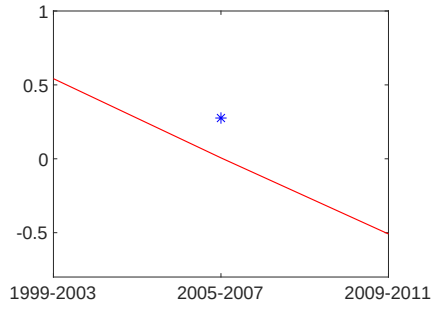
Results: preferences (over calendar time)



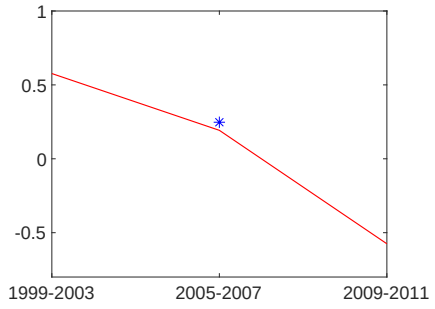
$\mathbb{E}(\eta_{cw_1(i)})$



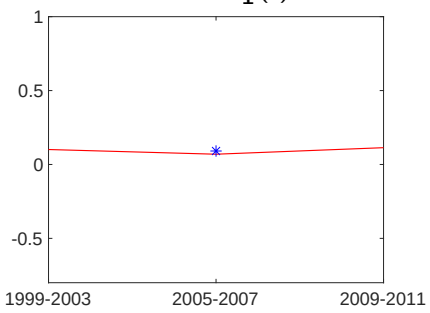
$\mathbb{E}(\eta_{cw_2(i)})$



$\mathbb{E}(\eta_{h_1w_1(i)})$



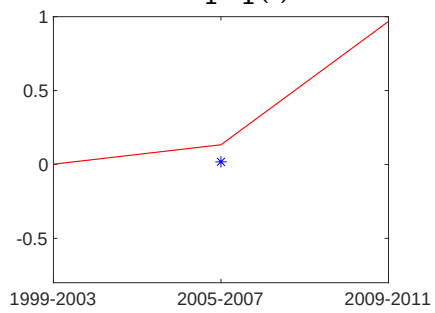
$\mathbb{E}(\eta_{h_2w_2(i)})$



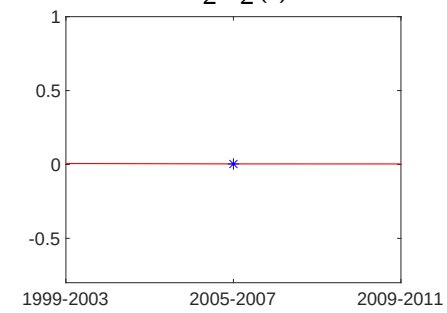
$\mathrm{Var}(\eta_{cw_1(i)})$



$\mathrm{Var}(\eta_{cw_2(i)})$



$\mathrm{Var}(\eta_{h_1w_1(i)})$

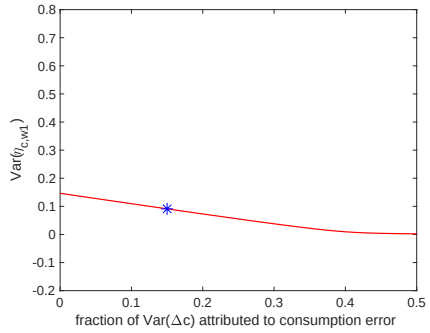


$\mathrm{Var}(\eta_{h_2w_2(i)})$

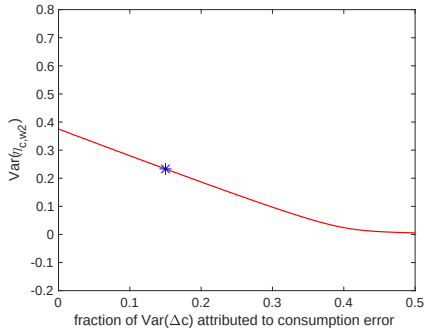
Selected parameters over different calendar periods: 1999-2003 (3 waves of PSID data), 2005-2007 (two waves), and 2009-2011 (two waves). I condition on the sample average of consumption and hours within each calendar period.

- $\mathbb{E}(\eta_{cw_j(it)})$ and $\mathrm{Var}(\eta_{cw_j(it)})$ stable
- $\mathbb{E}(\eta_{h_jw_j(i)})$ drops in 2009-2011, $\mathrm{Var}(\eta_{h_1w_1(i)})$ jumps: fragile results, they do not entertain economic explanation

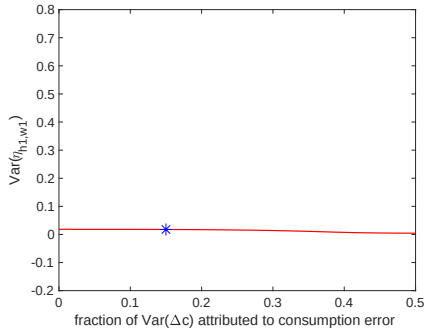
Results: preferences (over consumption error)



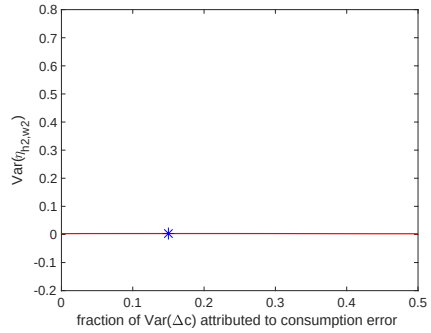
$\mathrm{Var}(\eta_{cw_1(i)})$



$\mathrm{Var}(\eta_{cw_2(i)})$



$\mathrm{Var}(\eta_{h_1 w_1(i)})$



$\mathrm{Var}(\eta_{h_2 w_2(i)})$

Variances of elasticities against the variance of consumption measurement error between zero and 50% $\times$ $\mathrm{Var}(\Delta c_{it})$. Measurement error in wages and earnings remains at 13% of the variance of wages and 4% of the variance of earnings.

- baseline: fix variance of consumption error at 15% of $\mathrm{Var}(\Delta \ln c_{it})$ – otherwise not identified in most specifications
- larger consumption error reduces scope of preferences in the model
- consumption pref heterogeneity substantial for consumption error up to 40% of $\mathrm{Var}(\Delta \ln c_{it})$; heterogeneity in labor supply elasticities always negligible
- but: if earnings & wage error increase proportionally to consumption error, consumption preference heterogeneity retains relative importance

Insurance role of family labor supply

- Transmission of permanent shocks depends on family labor supply
- More responsive labor supply implies lower transmission

Pass-Through Rates of Permanent Shocks $\mathbb{E}(\partial \Delta c_{it} / \partial v_{jit})$

		no labor supply responses by:		
		men	women	both
v_{1it}	0.452	0.411	0.498	0.497
v_{2it}	0.267	0.326	0.250	0.312

- Own labor supply exacerbates negative impact of shocks
- Spousal labor supply provides insurance - added worker (Lundberg 1985)
- Of 54.8 *p.p.* of partial insurance to male shocks, 8.2% comes from family labor supply - to female shocks: 6.1%

D.
Additional Results and Model Extensions

Are the baseline findings entirely new?

- **Heathcote et al. 2014**:
  - estimation with labor supply data reveal little role for heterogeneity
  - introducing consumption data makes role of heterogeneity paramount
- **Attanasio et al. 2018**:
  - heterogeneity in labor supply elasticity due to demographics and hours worked, both of which I control for here
- **Ghosh 2016**:
  - skewness and kurtosis moments suggest no insurance to permanent shocks
  - however, framework is one without family labor supply, so true partial insurance is likely underestimated

Progressive joint taxation

- Suppose earnings are taxed jointly in the household

$$T_{it}(\sum_{j=1}^{2} W_{jit} H_{jit}) = (1 - \chi_{it})(\sum_{j=1}^{2} W_{jit} H_{jit})^{1-\nu_{it}}$$

  - χ_{it} and ν_{it} determine proportionality and progressivity of tax system
  - analytical equations augmented by term that reflects family labor supply disincentives of joint taxation
  - but: outcomes no longer linear functions of moments of preferences
  - estimation based on simulation of preferences from $\mathcal{N}(\boldsymbol{\mu}, \boldsymbol{\Sigma})$, fix $\nu_{it} = 0.185$ as in Heathcote et al. 2014

- Main conclusions still hold:
  - $\mathrm{Var}(\eta_{cw_1(it)}) = 0.124$ and $\mathrm{Var}(\eta_{cw_2(it)}) = 0.318$ (p-val<0.01)
  - $\mathbb{E}(\eta_{h_1 w_1(it)}) = 0.326$ and $\mathbb{E}(\eta_{h_2 w_2(it)}) = 0.277$, slightly larger than baseline
  - labor supply elasticities drop when model targets 3rd moments (wage shocks still skewed, so C and Y still skewed)
  - negligible heterogeneity in labor supply elasticities

Home production

- Suppose true utility function is

$$U_{it}(C_{it}, H_{1it}, H_{2it}, D_{1it}, D_{2it}; \boldsymbol{Z}_{it})$$

  where D_{jit} is chores or childcare of spouse j

  - Blundell et al. 2018: household response to shocks depends on substitutability of parental childcare in home production
  - Boerma and Karabarbounis 2019: heterogeneity in domestic productivity may show up as heterogeneity in preferences

- Allowing for D complicates identification, abstracting from D may cause omitted variables bias
  - neglected heterogeneity in productivity or time use shares may bias true preference heterogeneity

- Address empirically: first stage controls for chores and age of children

- Results unchanged from baseline as baseline *anyway* controls for large # of observables, number of children, age of parents

Intra-household heterogeneity

- Suppose true utility function is

$$U_{it} := \mu_{it}^{(1)} U_{it}^{(1)}(C_{it}, H_{1it}; \boldsymbol{Z}_{it}^{(1)}) + \mu_{it}^{(2)} U_{it}^{(2)}(C_{it}, H_{2it}; \boldsymbol{Z}_{it}^{(1)})$$

  with C_{it} public consumption, μ_{it} intra-family bargaining power

- Assume: (1.) lack of commitment (Chiappori et al. 2020); (2.) transitory shocks do not shift μ_{it}

- Consumption dynamics given by

$$\begin{aligned}\Delta c_{it} \approx\ & \eta_{cw_1(it-1)}^{(1)} \nu_1(\boldsymbol{\eta}_{it-1}^{(1)}, \boldsymbol{\eta}_{it-1}^{(2)}; \mu_{it-1}) \Delta u_{1it} \\ & + \eta_{cw_2(it-1)}^{(2)} \nu_2(\boldsymbol{\eta}_{it-1}^{(1)}, \boldsymbol{\eta}_{it-1}^{(2)}; \mu_{it-1}) \Delta u_{2it} + \dots\end{aligned}$$

  with preferences now defined at individual level

- Heterogeneity in μ_{it} contributes to variation in Δc_{it} and Δy_{jit}
  - previously identified $\mathrm{Var}(\eta_{h_j w_j(it)})$ is now $\mathrm{Var}(\eta_{h_j w_j(it)} \times \nu_j(\cdot; \mu_{it}))$
  - but $\mathrm{Var}(\eta_{h_j w_j(it)}) = 0$ in baseline, upper bound for heterogeneity in $\nu_j(\cdot; \mu_{it})$

Wage process heterogeneity

- Suppose true wage process is $ARMA(1,1)$ with heterogeneous persistence (Hryshko and Manovskii 2017, Alan et al 2018)

$$\Delta w_{jit} = (\rho_{ji} - 1) w^{p}_{jit-1} + v_{jit} + \Delta\zeta_{jit} + \tau_{ji}\Delta\zeta_{jit-1}$$

  with ρ_{ji} AR parameter and τ_{ji} MA parameter

- Suppose for simplicity $u_{1it} = v_{1it} = 0$; consumption dynamics given by

$$\Delta c_{it} \approx \eta_{cw_2(it-1)}\widetilde{\rho}_{2it} + \eta_{cw_2(it-1)}\Delta\zeta_{2it} + f_2(\pi_{it}, s_{it}; \boldsymbol{\eta}_{it-1}, \rho_{2i})v_{2it}$$

  - term 1 captures variation in Δc_{it} due to heterogeneity in wage process

- Identification of moments of η_{cw_2} relies on ratios of intertemporal correlations – these are insensitive to wage specification
  - by contrast, contemporaneous moments (e.g. transmission of v_{2it}) depends on ρ_{ji} and picks up preference and wage heterogeneity

Time aggregation in the PSID

- First difference of *sum* or *average* of random walk exhibits serial correlation although underlying variable does not (e.g. Crawley 2020)
- Problem due to a time series being available at a lower frequency (e.g. annual earnings) than underlying variable (e.g. monthly salary)
- Suppose true wage process is monthly: $w_{jit,m} = w^{p}_{jit,m-1} + v_{jit,m} + u_{jit,m}$
  - there are $M = 12$ months in year
  - observed biennial wage growth is given by

$$\Delta w_{jit} = \sum_{m=0}^{M-1}(M-m)v_{jit,1+m} + M\sum_{m=1}^{M} v_{jit-1,m} + \sum_{m=1}^{M-1}(M-m)v_{jit-2,M+1-m} + \sum_{m=1}^{M}(u_{jit,m} - u_{jit-2,m})$$

  - depends on permanent shocks at $t-2$, identification must be adapted
- Conclusions unchanged after estimation with time aggregated process

Liquidity constraints & adjustment costs of work

- Estimation on pool of 'unconstrained' and 'hand-to-mouth' households
  - $\mathbb{E}(\eta_{cw_j(it)})$ biased $\uparrow$ if C-H Frisch substitutes as in Blundell et al. 2016
  - $\mathrm{Var}(\eta_{cw_j(it)})$ biased $\uparrow$; picks up variability in liquidity tightness
  - $\mathbb{E}(\eta_{h_j w_j(it)})$ biased $\downarrow$; reflects fixed hours
- These implications testable on pool of 'unconstrained'

Wealthy:	$A > \overline{C}$	$A > 2\overline{C}$	$A > \overline{C}$ no debt	$A > \overline{C}$ liquid
$\mathbb{E}(\eta_{cw_1(i)})$	-0.035 (0.025)	-0.028 (0.026)	0.028 (0.038)	0.083 (0.036)
$\mathbb{E}(\eta_{cw_2(i)})$	-0.055 (0.040)	-0.044 (0.041)	0.044 (0.061)	0.133 (0.057)
$\mathbb{E}(\eta_{h_1 w_1(i)})$	0.184 (0.203)	0.171 (0.219)	0.398 (0.439)	0.214 (0.443)
$\mathbb{E}(\eta_{h_2 w_2(i)})$	0.138 (0.133)	0.059 (0.146)	-0.055 (0.168)	-0.431 (0.174)
$\mathrm{Var}(\eta_{cw_1(i)})$	0.071 [0.000]	0.051 [0.000]	0.087 [0.000]	0.022 [0.034]
$\mathrm{Var}(\eta_{cw_2(i)})$	0.181 [0.000]	0.129 [0.000]	0.223 [0.000]	0.057 [0.034]
$\mathrm{Var}(\eta_{h_1 w_1(i)})$	0.005 [0.435]	0.004 [0.464]	0.009 [0.390]	0.047 [0.323]
$\mathrm{Var}(\eta_{h_2 w_2(i)})$	0.003 [0.424]	0.002 [0.429]	0.045 [0.147]	0.035 [0.097]
Observations	4614	3789	1806	1374

- Results do not clearly indicate presence of liquidity constraints
- Straightforward extension to additional type of agents: those who switch from 'hand-to-mouth' to 'unconstrained'

Quantitative model: technical details

- Parametric specification of quantitative model
  - homogeneous preferences:
    $U_t = \beta^t (1-\sigma)^{-1} \left(\{ \alpha C_{it}^{\gamma} + (1-\alpha)[\xi H_{1it}^{\theta} + (1-\xi) H_{2it}^{\theta}]^{-\frac{\gamma}{\theta}} \}^{\frac{1-\sigma}{\gamma}} - 1 \right)$
  - straightforward extension to preference heterogeneity
  - normal shocks: $(v_{1it}, v_{2it}) \sim \mathcal{N}(0, \Sigma)$
  - extension to skewness challenging, active research (e.g. De Nardi et. 2019)
- Baseline: heterogeneity in γ and θ, govern estimable Frisch elasticities
  - $(\gamma, \theta) = \{(-3, 3); (-2, 4); (-3.5, 2.3); (-3.9, 3.5)\}$

Quantitative model: additional results

- Extensions:
  - heterogeneity in discount factor $\beta_i = \{0.95; \ldots; 0.99\}$
  - heterogeneity in consumption IES $\sigma_i = \{2.1; 2.24; 2.8; 3.0\}$
  - 30% of households have no access to credit *and* debt in first 10 years equal to $1/4$ of average male earnings upon entry in the labor market

Quantitative Model: Estimates of Average Elasticities, Robustness

	heterogeneity in discount factor		heterogeneity in $\eta_{c,p}$		liquidity constraints	
	(1)	(2)	(3)	(4)	(5)	(6)
specification:	true	trans.	true	trans.	true	trans.
$\mathbb{E}(\eta_{cw_1(i)})$	-0.229	-0.178	-0.173	-0.178	-0.234	-0.229
$\mathbb{E}(\eta_{cw_2(i)})$	-0.104	-0.081	-0.075	-0.077	-0.104	-0.092
$\mathbb{E}(\eta_{h_1w_1(i)})$	1.009	0.933	0.858	0.860	1.016	1.023
$\mathbb{E}(\eta_{h_1w_2(i)})$	0.238	0.181	0.161	0.147	0.237	0.216
$\mathbb{E}(\eta_{h_2w_1(i)})$	0.509	0.436	0.357	0.354	0.515	0.524
$\mathbb{E}(\eta_{h_2w_2(i)})$	0.739	0.739	0.662	0.669	0.738	0.765

GMM estimates of first moments of wage elasticities on simulated data. Pooled population with four sub-populations of 50K households, each with own preferences. In addition to heterogeneity in Frisch elasticities, columns 1 & 2 feature heterogeneity in the discount factor, columns 3 & 4 feature heterogeneity in $\eta_{c,p}$, and columns 5 & 6 feature severe liquidity constraints.